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DIGITAL MINIMALLY INVASIVE SURGERY SYSTEM

Background of the Invention

The present invention relates to the art of image guided surgery. It finds particular application in conjunction with neurosurgical and orthopedic procedures and will be described with particular reference thereto. However, it is to be appreciated that the present invention is equally applicable to a wide range of image guided surgical applications in humans as well as veterinary applications.

Heretofore, images of a region of a patient in which surgery is planned have been made using magnetic resonance imaging systems, computed tomography, or other similar imaging modalities. These techniques generate a substantial amount of data, which is then manipulated through software to provide three-dimensional guidance within the imaged region. Typically, to facilitate diagnoses and treatment through image guidance, this data is manipulated using a computer supplemented with other specialized computer hardware to display selected views during surgery, e.g., orthogonal views, slices, perspective renderings, or the like.

Acquired images used for image guided surgery typically use anatomical reference markers which are commonly imaged with the patient. At the surgical site, acoustic, infrared, video camera, or other tracking technologies are utilized to determine the location of the

markers relative to the patient and the surgical site. Additional computer software is provided to register the coordinate system of the markers, hence the patient, with the image(s). Thereafter, the same system is used to monitor the current position of surgical tools instrumented with similar markers, and coordinate their position in physical space with their position in the image(s). In this manner, the current position of the tool or probe relative to obscured portions of the patient's anatomy is readily determined. This facilitates implementing minimally invasive techniques by allowing the surgeon to use the acquired image(s) to see below the visible surface of the patient. For example, the surgeon can use the software's graphic user interface to mark the entry point and proposed trajectory of a pedicle screw on a patient's spine. The marked image(s) can then be used to enable the surgeon to follow the trajectory created below the surface with the instrumented surgical tool to be sure that the screw will not impinge the spinal cord and that it will engage sufficient bone to anchor properly, and the like.

In prior image guided surgery systems, different tools have been used for different portions of the human anatomy. To accommodate the use of different tools, the surgeon typically needs to calibrate the tool to the system. That is, the system needs to know the length, diameter, distances between various portions of the tool and the markers mounted on the tool, relative locations of markers and a tool axis, and the like. Prior image guided surgery systems did not allow use of non-instrumented or standard surgical tools. Also, in prior image guided surgery systems, as new tools are developed or as tools are modified, information about the tools loaded into the system must be reloaded on the entire installed base. Similar reinstallation problems occur when improvements are made to the software.

Prior image guided surgery systems also relied on reusable surgical tools. This has several drawbacks. First, with use, tools with cutting edges become dull. Second, since the tools are sterilized between uses, infection to the patient is possible due to a potential failure of the sterilization procedure.

Typically, image guided surgery systems are universal, i.e., applicable to any portion of the human anatomy that can be clearly imaged with reference markers. Computer software is provided to handle the imaging and alignment needs in virtually any region of the human anatomy. In some instances, the image guided surgery software is incorporated directly into the diagnostic imaging device. In other instances, additional expensive hardware is provided separately.

Prior image guided surgery systems have also relied on a capital equipment sales model, which has resulted in limited market acceptance. Prior image guided surgery systems have been large in size and cost-prohibitive for most. The shipping logistics has been expensive and cumbersome.

The present invention contemplates a new and improved method for image guided surgery, which overcomes the above-referenced problems and several others.

Summary of the Invention

In accordance with one aspect of the present invention, a method of image guided surgery is provided which includes use of a (1) low cost integrated computer, (2) software-integrated disposable kits, (3) sterile disposable surgical tools and accessories, and a (4) tracking system used to locate the instrumented surgical tools during surgery.

In accordance with another aspect of the present invention, a low cost integrated computer is provided. The computer contains a portion of image guided surgery software to provide minimal user functionality